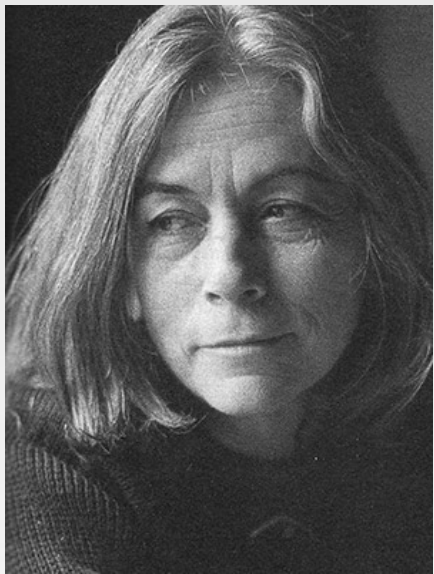# Module 3 Overview

Introduction

This module introduces to the SVM criterion and the practical implementation of the Support Vector Machine for classification. In the first set of slides we describe the methodology for the optimization of the SVM, and in the second one we complete the derivation and extract the essential properties of the SVM.

"I understood that you have to look at things from the outside so that order becomes order and makes sense."

--Carmen Martín Gaite.

Carmen Martín Gaite

Spanish writer.

The interest of the class sessions is fundamentally theoretical. In essence the student must have a clear idea of what is the mechanism that make the SVM work rather than treating the algorithm as a black box.

Learning Objectives

The students must be able to know how the SVM works from a theoretical perspective rather than from an algorithmic perspective. Therefore, the students must be able to:

- Use the criteria that lead to the SVM, which are:
  - Concept of margin
  - Margin maximization as an equivalent to complexity minimization.
- Explain and justify the construction of the primal functional to be minimized.
- Reproduce the Lagrangian analysis and the properties of the SVM:
  - The behavior of the SV. Saturated and non saturated SV.
  - Model parameters as a linear combination of the data.
- Explain the properties of the dual
- Put together a SVM for classification (after completing the homework).

Module 3 Summary

- Slides (Theory)
- Quizzes
- Assignment 3.1
- Assignment 3.2
- Install the SVM packages (See the installation and example videos)

Required Instructional Materials

- The materials consists of the class lessons, after which students can proceed to a self assessment through the quizzes.

Activities

- After completing the theory and the quizzes, the students will need to turn in two homework.
  - The first homework is simply a summary of the theory. It will be used later in the homework of next module, which consists of writing a research type paper. While this homework can have free style, it is recommended that you organize the work in a structured way, as indicated in the problem statement or any alternative structures.
  - The second homework is intended to put together an SVM. Whit it you will be able to see the properties of the SV and the effect of increasing the complexity. **Please follow the rubric**.

Supplementary materials

There are a number of good books and papers that can be used to further study the SVM. Here we recommend to use the following documents, both available with open access.

Support vector machines for classification: Students are required to download the paper "A Tutorial on Support Vector Machines for Pattern Recognition", by Christopher Burges.

The Elements of Statistical Learning, T. Hastie et al.